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## ERTS Proposal No. 108

### Remote Sensing of Ocean Currents

George A. Maul, Principal Investigator, GSFC ID-C0315

#### OBJECT

The object of this investigation is to locate ocean current boundaries by sensing the color change associated with the cyclonic edge of the zone of maximum horizontal velocity shear. The test site is the eastern Gulf of Mexico where the strongly baroclinic flow from the Yucatan Straits forms into the Loop Current. The research will attempt to use ERTS data in the investigation of ocean color sensing from simultaneous observations by ship and satellite.

#### FIELD DATA COLLECTION

A time-series of the Loop Current is being obtained by occupying the suborbital track of ERTS that passes into the Yucatan Straits every 36 days. The research vessel is on the suborbital track on the day of satellite transit collecting continuous chlorophyll-a and radiometric temperature (in conjunction with the NOAA-2 IR sensors); hourly (15 km interval) expendable bathythermograph, volume scattering, surface bucket temperature and salinity samples are being obtained. During daylight, spectra of upwelling and downwelling radiance (400-800 nm) are being measured with a  $\frac{1}{4}$  meter Ebert scanning spectroradiometer. Upon reaching the Yucatan Straits a temperature/salinity/depth (STD) transect of nine stations is being made in order to determine the geostrophic current and transport fields. After the STD transect, the surface boundary of the Loop Current is being tracked using the same measurements outlined for the sub-satellite track. A second STD transect of the Florida Straits from Key West to Havana is made in order to determine the discharge from the basin.

#### WORK SUMMARY

Two cruises were undertaken during the reporting period. Severe weather conditions limited the January cruise to the transect line and several XBT transects to help define the northern limit of the current. In February no STD stations

(E73-10022)<sup>0</sup> REMOTE SENSING OF OCEAN  
CURRENTS Bimonthly Report, 4 Jan. - 4  
Mar. 1973 (National Oceanic and  
Atmospheric Administration) 8 p HC \$3.00

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were obtained due to instrument failure; the suborbital trackline was shortened considerably because the cruises are now based out of Miami instead of St. Petersburg. The attached cruise reports detail the field trips.

The computer facilities at Patrick Air Force Base were used for investigative analysis of ocean features of New York Bight oriented ERTS data. Using the digital data the effect of contrast stretching and range emphasis was made. The dynamic range of ocean features is only about 5% of the entire range present in a scene and must be greatly emphasized to ensure that all pertinent data are made available for subsequent analyses. Initial analysis indicates that there is subsequently more ocean information on a frame than is ordinarily visible in the normally processed scene.

Programs have been written to use NOAA's Digital Muirhead Display (DMD); the first successful run was accomplished this week. In this run, a portion of the 16 August New York Bight scene was contrast stretched to bring out what has been interpreted by some as internal waves. The success has been encouraging and scenes with lower signal to noise ratio in the deep ocean will be studied.

A paper entitled, "Remote Sensing of Ocean Currents Using ERTS Imagery", was presented at the ERTS Symposium in Washington. Highlights of several topics discussed in these reports were given. Theoretical calculations were made that support the concern given in earlier reports of the dominant effect of sea state on upwelling light. It was further shown that sea state effects the spectrum in a wavelength dependent manner making ratioing/differencing techniques a three channel problem. The magnitude of the effect is to be studied by an aircraft experiment described in the last report.

#### WORK PLANS

The field work will continue in order to be on the suborbital track for the 24 March and 29 April transits. Routine processing of the cruise data will continue as before.

The aircraft experiment discussed before is now planned for the next reporting period. The flight is weather dependent; since this is an add-on study, it must be coordinated with the NOAA PI and aircraft availability.

Image enhancement plans include experiments with different gamma functions and contrast stretching. Ratioing and differencing will be started pending completion of further theoretical studies; initially these will be in the form of profiles rather than whole images.

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORY  
PHYSICAL OCEANOGRAPHY LABORATORY  
NASA/GSFC

CRUISE REPORT  
M/V VENTURE

9-13 January 1973

I. OBJECTIVES

The purpose of this cruise was to continue a time series of the location of the Loop Current as part of AOML's project with the Earth Resources Technology Satellite (ERTS) and the NOAA-2 Meteorological Satellite. The research vessel steamed along the suborbital track of ERTS that leads into the Yucatan Channel on the day of satellite transit. The research is intended to obtain baseline information on the spectroradiometric properties of the ocean's surface useful for remote sensing and the detection of that information at orbital altitudes.

II. ACTUAL SCHEDULE

<u>Date</u>	<u>Time</u>	<u>Activity</u>
January	EST	
9	1830	Departed Key West
11	1000	Satellite Transit
12	0030	Break off survey due to weather
13	1000	Arrive Key West

III. STATION POSITIONS

The suborbital track occupied had the following beginning and ending coordinates:

27°44'N	84°30'W
22°32'N	85°34'W

#### IV. PERSONNEL

G. Maul, Chief Scientist	NOAA/AOML
J. Hazelworth	NOAA/AOML
R. Qualset	NOAA/AOML
M. Ednoff	FSU

#### V. DESCRIPTION OF OPERATIONS

Data collection commenced at the northern end of the suborbital track. Continuous flow measurements of chlorophyll-a were not obtained due to fluorometer failure; continuous radiometric sea surface temperature was recorded on a dual channel recorder. While on the track, hourly XBT's, surface bucket temperature, and surface salinity were taken. Spectra of upwelling and downwelling visible radiation and measurements of scattering ratios were not observed due to rough seas. Loran A fixes were made at one hour intervals and at major course, and/or speed changes.

Easterly winds in excess of 30 knots blew during the entire survey. In the current the seas were 4-6 meters. On the night of 12 January, gusts in excess of 50 knots were encountered; all scientific operations were secured and the captain, with the concurrence of the chief scientist, turned for sheltered waters. A second XBT section was obtained on the return leg. The following week, under calmer weather conditions a deep sea tide gauge was retrieved by H. Mofjeld. He obtained two additional crossings which gave us a reasonably good view of the shape of the Loop Current for the month.

#### VI. LOGS

- Chief Scientist Log
- Deck Log
- Track Chart
- Loran Log (C&GS 722)
- Hydrographic Station Log
- Bathythermograph Log

Submitted by: George A. Maul  
January 21, 1973

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORY  
PHYSICAL OCEANOGRAPHY LABORATORY  
NASA/GSFC

CRUISE REPORT  
R/V VIRGINIA KEY

13-19 February 1973

I. OBJECTIVES

The purpose of this cruise was to continue a time series of the location of the Loop Current as part of AOML's project with the Earth Resources Technology Satellite (ERTS) and the NOAA-2 Meteorological Satellite. The research is intended to obtain baseline information on the spectroradiometric properties of the ocean's surface useful for remote sensing and the detection of that information at orbital altitudes.

II. ACTUAL SCHEDULE

<u>Date</u>	<u>Time</u>	<u>Activity</u>
February EST		
13	1500	Depart Miami
14	0800	Arrive Key West; fuel
	1500	Depart Key West
	1700	Commenced XBT transect of Florida Straits
15	2145	Commence XBT transect of Yucatan Straits
16	0700	Commence tracking current
	1000	Satellite Transit
18	1830	Complete Sruvey
19	1800	Arrive Miami

### III. STATION POSITIONS

The northern limit XBT transect of the Florida Straits was at the 100-fathom curve south of Marquesa Key Light and terminated 12 n. mi. north of Havana Cuba. The station locations were:

24° 21' N	82-14W	Station 10
24° 11' N	82-16W	11
24° 01' N	82-18W	12
23° 51' N	82-21W	13
23° 41' N	82-23W	14
23° 31' N	82-26W	15
23° 21' N	82-28W	16

The station locations for the Yucatan Straits XBT transect were:

21 50' N	85 11' W	Station 1
21 48' N	85 21' W	2
21 46' N	85 32' W	3
21 44' N	85 42' W	4
21 42' N	85 53' W	5
21 40' N	86 03' W	6
21 38' N	86 13' W	7
21 36' N	86 24' W	8
21 34' N	86 34' W	9

The easternmost station was 12 n. mi. west of Cabo San Antonio; the westernmost station was 12 n. mi. east of Isla Contoy.

The cruise from Isla Contoy to Dry Tortugas was a saw-toothed path, which crossed the surface boundary layer zone of the current.

### IV. PERSONNEL

G. Maul, Chief Scientist	NOAA/AOML
M. Ednoff	FSU
C. Thacker	NOAA/AOML

## V. DESCRIPTION OF OPERATIONS

Data collection commenced with a T-7 XBT transect of the Florida Straits; the STD was non-operational. Continuous flow measurements of chlorophyll-a and continuous radiometric sea surface temperature were recorded on a dual channel recorder. While on the track, hourly XBT's, surface bucket temperature, surface salinity, and measurements of scattering ratios were taken. Spectra of upwelling and downwelling visible radiation were not observed. Loran A fixes were made at one hour intervals and at major course, and/or speed changes. One liter samples were filtered for a spectrophotometer calibration of chlorophyll-a every six hours and at major changes in the fluorescence, and for biological samples.

With the change in vessels to the VIRGINIA KEY, the cruise plan was revised. This saved 300 n. mi. over the old plan which was developed for a home port of St. Petersburg. The suborbital track is considerably shortened with the plan to occupy about 50 miles of it each trip, as part of the current tracking routine.

## VI. LOGS

- Chief Scientist Log
- Deck Log
- Track Chart
- Loran Log (C&GS 722)
- Hydrographic Station Log
- Bathymograph Log

Submitted by: George A. Maul  
February 25, 1973